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Health Effects Assessment for Hexachloroethane

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16. ABSTRACT

This report summarizes and evaluates information relevant to a preliminary interim assessment of adverse health effects associated with specific chemicals or compounds. The Office of Emergency and Remedial Response (Superfund) uses these documents in preparing cost-benefit analyses under Executive Order 12991 for decision-making under CERCLA. All estimates of acceptable intakes and carcinogenic potency presented in this document should be considered as preliminary and reflect limited resources allocated to this project. The intent in these assessments is to suggest acceptable exposure levels whenever sufficient data are available. The interim values presented reflect the relative degree of hazard associated with exposure or risk to the chemical(s) addressed. Whenever possible, two categories of values have been estimated for systemic toxicants (toxicants for which cancer is not the endpoint of concern). The first, RfD_S or subchronic reference dose, is an estimate of an exposure level that would not be expected to cause adverse effects when exposure occurs during a limited time interval. The RfD is an estimate of an exposure level that would not be expected to cause adverse effects when exposure occurs for a significant portion of the lifespan. For compounds for which there is sufficient evidence of carcinogenicity, q_1^*s have been computed, if appropriate, based on oral and inhalation data if available.

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HEALTH EFFECTS ASSESSMENT FOR HEXACHLOROETHANE

ENVIRONMENTAL CRITERIA AND ASSESSMENT OFFICE
OFFICE OF HEALTH AND ENVIRONMENTAL ASSESSMENT
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
CINCINNATI, OH 45268

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PREFACE

This report summarizes and evaluates information relevant to a preliminary interim assessment of adverse health effects associated with hexachloroethane. All estimates of acceptable intakes and carcinogenic potency presented in this document should be considered as preliminary and reflect limited resources allocated to this project. Pertinent toxicologic and environmental data were located through on-line literature searches of the TOXLINE and the CHEMFATE/DATALOG data bases. The basic literature searched supporting this document is current up to May, 1986. Secondary sources of information have also been relied upon in the preparation of this report and represent large-scale health assessment efforts that entail extensive peer and Agency review. The following Office of Health and Environmental Assessment (OHEA) sources have been extensively utilized:

U.S. EPA. 1980a. Ambient Water Quality Criteria Document for Chlorinated Ethanes. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Water Regulations and Standards, Washington, DC. EPA 440/5-80-029. NTIS PB81-117400.

U.S. EPA. 1983. Reportable Quantity Document for Hexachloroethane. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Emergency and Remedial Response, Washington, DC.

The intent in these assessments is to suggest acceptable exposure levels for noncarcinogens and risk cancer potency estimates for carcinogens whenever sufficient data were available. Values were not derived or larger uncertainty factors were employed when the variable data were limited in scope tending to generate conservative (i.e., protective) estimates. Nevertheless, the interim values presented reflect the relative degree of hazard or risk associated with exposure to the chemical(s) addressed.

Whenever possible, two categories of values have been estimated for systemic toxicants (toxicants for which cancer is not the endpoint of concern). The first, RfD_S (formerly AIS) or subchronic reference dose, is an estimate of an exposure level that would not be expected to cause adverse effects when exposure occurs during a limited time interval (i.e., for an interval that does not constitute a significant portion of the lifespan). This type of exposure estimate has not been extensively used, or rigorously defined, as previous risk assessment efforts have been primarily directed towards exposures from toxicants in ambient air or water where lifetime exposure is assumed. Animal data used for RFD_S estimates generally include exposures with durations of 30-90 days. Subchronic human data are rarely available. Reported exposures are usually from chronic occupational exposure situations or from reports of acute accidental exposure. These values are developed for both inhalation (RfD_{SI}) and oral (RfD_{SO}) exposures.

The RfD (formerly AIC) is similar in concept and addresses chronic exposure. It is an estimate of an exposure level that would not be expected to cause adverse effects when exposure occurs for a significant portion of the lifespan [see U.S. EPA (1980b) for a discussion of this concept]. The RfD is route-specific and estimates acceptable exposure for either oral (RfD_O) or inhalation (RfD_I) with the implicit assumption that exposure by other routes is insignificant.

Composite scores (CSs) for noncarcinogens have also been calculated where data permitted. These values are used for identifying reportable quantities and the methodology for their development is explained in U.S. EPA (1984).

For compounds for which there is sufficient evidence of carcinogenicity RfD_S and RfD values are not derived. For a discussion of risk assessment methodology for carcinogens refer to U.S. EPA (1980b). Since cancer is a process that is not characterized by a threshold, <u>any</u> exposure contributes an increment of risk. For carcinogens, q_1^*s have been computed, if appropriate, based on oral and inhalation data if available.

ABSTRACT

In order to place the risk assessment evaluation in proper context, refer to the preface of this document. The preface outlines limitations applicable to all documents of this series as well as the appropriate interpretation and use of the quantitative estimates presented.

In a chronic gavage study, high doses of hexachloroethane were associated with a significant and dose-related increase in the incidence of hepatocellular carcinoma in B6C3F1 mice of both sexes. U.S. EPA (1980a) computed a q_1^* of 1.42×10^{-2} $(mg/kg/day)^{-1}$ based on the incidence in male mice and has subsequently assigned an EPA Group C classification. Two more recent analyses (U.S. EPA, 1982, 1986a) have derived RfDs for hexachloroethane based on noncarcinogenic endpoints.

In this document, the q_1^* of 1.42×10^{-2} for oral exposure is adopted and RfD, RfD_S values and CSs are not calculated.

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Scientists from the following U.S. EPA offices provided review comments for this document series:

Environmental Criteria and Assessment Office, Cincinnati, OH
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Office of Drinking Water

Editorial review for the document series was provided by the following:

Judith Olsen and Erma Durden
Environmental Criteria and Assessment Office
Cincinnati, OH

Technical support services for the document series was provided by the following:

Bette Zwayer, Jacky Bohanon and Kim Davidson
Environmental Criteria and Assessment Office
Cincinnati, OH

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LIST OF ABBREVIATIONS

CS	Composite score
K_{oc}	Soil sorption coefficient
LOAEL	Lowest-observed-adverse-effect level
NOAEL	No-observed-adverse-effect level
NOEL	No-observed-effect level
PEL	Permissible exposure limit
ppm	Parts per million
RfD	Reference dose
RfD_I	Inhalation reference dose
RfD_O	Oral reference dose
RfD_S	Subchronic reference dose
RfD_{SI}	Subchronic inhalation reference dose
RfD_{SO}	Subchronic oral reference dose
TLV	Threshold limit value
TWA	Time-weighted average

1. ENVIRONMENTAL CHEMISTRY AND FATE

The relevant chemical and physical properties and environmental fate of hexachloroethane (CAS No. 67-72-1) are listed in Table 1-1.

In the atmosphere, hexachloroethane should exist primarily in the vapor phase. It is expected to be unreactive in the troposphere and diffuse into the stratosphere where significant photodissociation can occur (Callahan et al., 1979; U.S. EPA, 1986b). Since the lifetime of hexachloroethane in the troposphere is unknown (Callahan et al., 1979), it is not possible to estimate the transfer rate of tropospheric hexachloroethane to the stratosphere. Monitoring data indicate that hexachloroethane will be removed from the atmosphere by rainfall (Pankow et al., 1984). In water, volatilization is apparently the dominant removal mechanism. The aquatic half-life is based on the measured volatilization half-life for hexachloroethane from a stirred (200 ppm) dilute (1 ppm), aqueous solution of 6.5 cm depth. (Dilling, 1977). Callahan et al. (1979) reported that the evaporative half-lives of hexachloroethane in aquatic media may range up to several hours.

Hexachloroethane should be moderately adsorbed to suspended solids and sediments and may bioaccumulate in some aquatic species. The half-life of hexachloroethane in soil could not be located in the available literature. Based on its estimated K_{oc} value, hexachloroethane should be moderately mobile in soil (Swann et al., 1983). The volatility of this compound from aquatic media indicates that volatilization from soil surfaces may be a significant removal mechanism.

TABLE 1-1

Relevant Chemical and Physical Properties and
Environmental Fate of Hexachloroethane

Property	Value	Reference
Chemical class:	halogenated aliphatic compound	
Molecular weight:	236.74	
Vapor pressure at 20°C:	0.21 mm Hg	MacKay and Shiu, 1981
Water solubility at 22°C:	50 mg/ℓ	MacKay and Shiu, 1981
Log octanol/water partition coefficient:	4.04	Hansch and Leo, 1985
Bioconcentration factor:	139, bluegill sunfish (Lepomis macrochirus)	Veith et al., 1980
	513-1202, rainbow trout (Salmo gairdneri)	Oliver and Niimi, 1983
Soil adsorption coefficient:	173 (estimated)	Sabljic, 1984
Half lives in Air:	years	Callahan et al., 1979; U.S. EPA, 1986b; Dilling, 1982
Water:	≤ several hours	Dilling, 1977; Callahan et al., 1979
Soil:	NA	

NA = Not available

2. ABSORPTION FACTORS IN HUMAN AND EXPERIMENTAL ANIMALS

2.1. ORAL

Data briefly reviewed by IARC (1979) indicate that hexachloroethane is rapidly and nearly completely absorbed. Within 3 days after ingestion of 500 mg/kg of ^{14}C-hexachloroethane, 5% of the radioactivity was identified in the urine of rabbits and between 14 and 24% of the administered radioactivity was identified in the expired air (Jondorf et al., 1957). Without providing data regarding fecal excretion of radioactivity, IARC (1979) stated that "the rest" of the administered dose was retained in the carcass. In sheep, hexachloroethane appeared rapidly in the systemic circulation after oral administration (Fowler, 1969).

2.2. INHALATION

Quantitative data regarding the absorption of hexachloroethane after inhalation exposure could not be located in the available literature.

3. TOXICITY IN HUMANS AND EXPERIMENTAL ANIMALS

3.1. SUBCHRONIC

3.1.1. Oral. In a subchronic feeding study by Dow Chemical Company, groups of 10 male and 10 female Fischer 344 rats were fed diets targeted to provide 3, 30 or 100 mg/kg/day for 16 weeks (Gorzinski et al., 1985). Sublimation of hexachloroethane from the food was a factor in this study; the investigators determined that the rats actually received 0, 1, 15 or 62 mg/kg/day of hexachloroethane from their food for the 16-week exposure period. The dosages were estimated by the investigators from body weights, food consumption and diet analysis data. Endpoints evaluated included body and organ weights, hematology, clinical chemistry, urinalysis and histopathology of the major organs in the high-dose and control groups and of the liver and kidneys in all experimental groups. At the high-dose level, increased relative and absolute liver and kidney weights were observed in the males and increased relative, but not absolute, liver weight in the females. Slight swelling of hepatocytes was also observed in high-dose males. Atrophy and degeneration of the renal tubules were observed in high-dose male and female rats. At 15 mg/kg/day of hexachloroethane, atrophy and degeneration of renal tubules were observed without any changes in relative or absolute kidney weight in the males. The incidence of kidney lesions in mid- and high-dose male rats appeared to be dose-related. No effects were reported in females ingesting 15 mg/kg/day of hexachloroethane. No effects were reported in either sex ingesting 1 mg/kg/day of hexachloroethane. There were no effects on food consumption, body weight gains, hematologic or biochemical parameters or urinalysis in any of the doses tested.

The NTP (1983) performed a subchronic gavage study in F344 rats in preparation for a chronic carcinogenicity experiment still in progress.

Only a draft report of this study consisting of the narrative without the tables of incidence data is available. Groups of 10 male and 10 female rats were treated by gavage with 0, 47, 94, 188, 375 or 750 mg/kg/day of hexachloroethane 5 days/week for 13 weeks (NTP, 1983). Endpoints evaluated included body and organ weights, hematology, clinical chemistry, urinalysis and histology of the major organs of control and high-dose males and females and of the males treated with 375 mg/kg/day of hexachloroethane. Only the kidney were evaluated in males receiving the lowest dosage; the kidneys and the liver were evaluated in the females receiving the four lowest dosages of hexachloroethane and in the males receiving 94 or 188 mg/kg/day of hexachloroethane. Convulsions were observed in male and female rats treated with $\geq$375 mg/kg/day of hexachloroethane; five high-dose males and two high-dose females died during the treatment period. Rate of body weight gain was unaffected except for a significant depression in high-dose males. Hyperactivity was reported in both sexes receiving $\geq$94 mg/kg/day. At necropsy, grossly granular, pale or reddened kidneys were noted in male rats at $\geq$94 mg/kg; these lesions were not seen in female rats. A granular appearing liver, however, was observed in female rats at $\geq$375 mg/kg. Biologically and statistically significant alterations in relative organ weights included kidney weights in 375 and 750 mg/kg males and liver and kidney weights in 375 and 750 mg/kg females. A dose-related increase in renal tubular nephrosis was observed in all treated groups of male rats; renal papillary necrosis and a severe hemorrhagic necrosis of the urinary bladder were seen in high-dose males that had died. In females, "minimal tubular changes in the kidney occurred only at 750 mg/kg. Hepatic lesions prevailed in female rats and consisted of focal hepatocellular necrosis, predominantly at 375 and 750 mg/kg. Granular and cellular casts and the

presence of epithelial cells and blood cells in the urine were observed in all treated males, whereas granular, but not cellular, casts occasionally occurred in the urine of 3/10 control males.

3.1.2. Inhalation. Weeks et al. (1979) exposed groups of 25 male and 25 female Sprague-Dawley rats, 4 male beagle dogs and 10 male Hartley guinea pigs by inhalation to 0, 15, 48 or 260 ppm (0, 145, 465 or 2520 mg/m^3) of hexachloroethane for 6 hours/day, 5 days/week for 6 weeks. Half the animals were killed after 6 weeks of treatment and the rest were killed 12 weeks after the end of treatment. Endpoints evaluated included body and organ weight changes, overt signs of toxicity and survival rates in all species, behavioral evaluation in 15 male rats, sensitization in guinea pigs, pulmonary function, hematology and clinical chemistry in the dogs and histopathology of major organs in all the rats and dogs. Adverse effects were seen in rats, dogs and guinea pigs exposed to 260 ppm, but not at lower levels. Two rats died during treatment. In addition, increased relative kidney, spleen, testes and lung weights and decreased body weight gains in the males and increased relative liver weight in the females were observed. Tremors and an increased incidence and severity of mycoplasma-related lesions in the respiratory epithelium in the males and females were also observed in rats exposed to 260 ppm. No behavioral effects were observed. One of four dogs exposed to 260 ppm died, tremors, ataxia and hypersalivation also occurred during exposure. No other exposure-related effects were observed. Four of the 10 guinea pigs exposed to 260 ppm died during treatment, but increased sensitization to hexachloroethane was not observed. No effects related to hexachloroethane exposure were observed in rats, dogs or guinea pigs exposed to 15 or 48 ppm.

3.2. CHRONIC

3.2.1. Oral. In the NCI (1978) bioassay, both Osborne-Mendel rats (50/sex/group) and B6C3F1 mice (50/sex/group) were treated by gavage with hexachloroethane in corn oil. Detailed treatment regimens are described in Section 4.2.1. Depression in the rate of body weight gain occurred in a dose-related manner in males and in high-dose females. Overt signs of toxicity occurred in all treated groups of rats and included a hunched appearance, abdominal urine stains, tremors, ataxia and abnormal ocular and vaginal discharge.

A dose-related increased mortality rate, beginning within the first 5 weeks of treatment, and a dose-related increased incidence of renal tubular nephropathy were seen in rats treated with a TWA dosage of 212 or 423 mg/kg/day of hexachloroethane. Toxic tubular nephropathy occurred in 0/20 untreated control, 0/20 vehicle control, 22/49 low-dose and 33/50 high-dose males, and in 0/20 untreated control, 0/20 vehicle control, 9/50 low-dose and 29/49 high-dose females. No other significant lesions were reported in the rats. In addition to an increased incidence of hepatocellular carcinoma (Section 4.2.1.), an increased incidence of toxic nephropathy was seen in the mice treated with a TWA dosage of 590 or 1179 mg/kg/day of hexachloroethane. The toxic nephropathy occurred in 0/18 untreated control, 0/20 vehicle control, 49/50 low-dose and 47/49 high-dose males and in 0/18 untreated control, 0/20 vehicle control, 50/50 low-dose and 45/50 high-dose females. There were no clear-cut effects on survival but survival of control males was measurably low; body weight was not affected. Treated mice had an increased incidence of a hunched appearance starting at week 28.

3.2.2. Inhalation. Pertinent data regarding the toxic effects of chronically inhaled hexachloroethane could not be located in the available literature.

3.3. TERATOLOGY AND OTHER REPRODUCTIVE EFFECTS

3.3.1. Oral. Groups of 22 pregnant Sprague-Dawley rats were treated by gavage with 0, 50, 100 or 500 mg/kg/day of hexachloroethane in corn oil on days 6-16 of gestation and were killed on day 20 (Weeks et al., 1979). Endpoints evaluated included maternal and fetal body weight, fetal length and sex and the number of corpora lutea implantation sites, resorption sites and viable fetuses. All fetuses with gross malformations and 4/sex/litter without gross malformations were fixed for examination for soft tissue and skeletal malformations. There was no significant increase in the incidence of soft tissue or skeletal malformations in the offspring of treated rats compared with controls. A decrease in the number of viable fetuses/dam as well as an increase in resorption rates were observed in the rats treated with 500 mg/kg/day of hexachloroethane. In addition, the maternal body weight of rats treated with 500 mg/kg/day was significantly decreased and tremors were observed in the dams on days 15 and 16 of gestation. Evidence of upper respiratory tract infections was apparent in 70% of the high-dose rats, but in only 10% of controls.

3.3.2. Inhalation. Groups of 22 pregnant Sprague-Dawley rats were exposed to 0, 15, 48 or 260 ppm (0, 145, 465 or 2520 mg/m^3) of hexachloroethane for 6 hours/day on days 6-16 of gestation and were killed on day 20 (Weeks et al., 1979). Endpoints evaluated included maternal and fetal body weight, fetal length and sex and the number of corpora lutea, implantation sites, resorption sites and viable fetuses. All fetuses with gross malformations and 4/sex/litter without gross malformations were fixed for examination for soft tissue and skeletal malformations. There was no increase in the incidence of soft tissue or skeletal malformations in treated rats compared with controls, and no evidence of fetotoxicity. Decreased maternal body weight was observed in dams inhaling 48 or 260 ppm of hexachloroethane.

Tremors were reported in the dams exposed to 260 ppm of hexachloroethane. Increased mucopurulent nasal exudate was observed in 85% of the dams exposed to 48 ppm (465 mg/m^3) and in 100% of the dams exposed to 260 ppm (2520 mg/m^3) of hexachloroethane, compared with ~10% in controls.

4. CARCINOGENICITY

4.1. HUMAN DATA

4.1.1. Oral. Pertinent data regarding the carcinogenicity of ingested hexachloroethane in humans could not be located in the available literature.

4.1.2. Inhalation. Pertinent data regarding the carcinogenicity of inhaled hexachloroethane in humans could not be located in the available literature.

4.2. BIOASSAYS

4.2.1. Oral. In a study conducted by the National Cancer Institute (NCI, 1978; Weisburger, 1977) groups of 50 male and 50 female Osborne-Mendel rats and 50 male and 50 female B6C3F1 mice were treated by gavage with hexachloroethane (≥98% purity) in corn oil 5 days/week for 78 weeks. Groups of 20 rodents/sex/species served as vehicle controls and the same numbers of rodents served as untreated controls. After 22 weeks of treatment, the rats received no treatment for 1 week alternated with 4 weeks of treatment during weeks 23 through 78 and were observed for an additional 33 or 34 weeks. The TWA 5 days/week dosages for the 78-week treatment period were 212 and 432 mg/kg for the rats. The mice received treatment for 78 weeks and were observed for an additional 12 weeks. The TWA 5 days/week dosages for the 78-week treatment period were 590 and 1179 mg/kg for the mice. Although the treated rats had a higher total number of tumors, which included interstitial-cell tumors of testes and renal tubular-cell adenomas in male rats and pituitary chromophobe adenomas in female rats, there was no statistically significant association between hexachloroethane treatment and tumor formation in the rats. The increased mortality rate, however, may have precluded observation of late developing tumors. In treated mice, there was a statistically significant, dose-related increase in the incidence of hepatocellular carcinomas in both sexes. The incidences in males were 6/60

(10%) pooled vehicle controls, 3/20 (15%) matched vehicle controls, 15/50 (30%) low dose and 31/49 (63%) high dose. The incidences in females were 2/60 (3%) pooled vehicle controls, 2/20 (10%) matched vehicle controls, 20/50 (40%) low dose and 15/49 (31%) high dose. On the basis of these data, the NCI (1978) concluded that hexachloroethane was carcinogenic to male and female B6C3F1 mice.

Another chronic carcinogenicity and toxicity experiment with hexachloroethane has been performed by gavage in rats (NTP, 1986) and the chronic quality assessment is in progress.

4.2.2. Inhalation. Pertinent data regarding the carcinogenicity of inhaled hexachloroethane in animals could not be located in the available literature.

4.3. OTHER RELEVANT DATA

Hexachloroethane was not mutagenic to Salmonella typhimurium strains TA1535, TA1537, TA1538, TA100 or TA98 or to Saccharomyces cerevisiae strain D4 with or without metabolic activation (Weeks et al., 1979). Although some cytotoxicity was exhibited, hexachloroethane was negative in the BALB/c-3T3 cell transformation assay in the absence of an exogenous metabolic activation system (Tu et al., 1985). The effect of hexachloroethane on cultivated BALB/c-3T3 cells was not evaluated in the presence of an exogenous metabolic activation system.

4.4. WEIGHT OF EVIDENCE

Applying the criteria described in the U.S. EPA guidelines for assessment of carcinogenic risk (U.S. EPA, 1986a), hexachloroethane may be classified in Group C, Possible Human Carcinogen, which is reserved for agents

with limited evidence of carcinogenicity in animals and an absence of human data. This classification was determined for EPA's CERCLA reportable quantity proposed rule making (U.S. EPA, 1986c). IARC has not classified hexachloroethane regarding its carcinogenicity to humans (IARC, 1982).

5. REGULATORY STANDARDS AND CRITERIA

The ACGIH (1986a,b) has recommended a TWA TLV of 10 ppm (~100 mg/m³) based on the Weeks et al. (1979) study, which reported that no adverse effects were observed in rats, dogs or guinea pigs exposed to 15 or 48 ppm (145 or 465 mg/m³) of hexachloroethane. The former TLV was 1 ppm. The skin notation was dropped based on low dermal toxicity reported by Weeks et al. (1979). The current OSHA PEL for hexachloroethane is 1 ppm (~10 mg/m³) (OSHA, 1985). NIOSH (1985), however, recommends that hexachloroethane be treated as if it were a carcinogen.

A q_1^* of 1.42×10^{-2} $(mg/kg/day)^{-1}$ of hexachloroethane for humans has been estimated by the U.S. EPA (1980a), based on the dose-response data for the induction of hepatocellular carcinomas in male B6C3F1 mice (NCI, 1978). The corresponding dose associated with an increased lifetime cancer risk of 10^{-5} is 7.04×10^{-4} mg/kg/day (0.70 µg/kg/day or 49 µg/day for a 70 kg man). The value was used to calculate the ambient water quality criterion of 19 µg/ℓ (assuming consumption of contaminated drinking water, fish and shellfish), corresponding to an increased lifetime cancer risk of 10^{-5}.

6. RISK ASSESSMENT

6.1. SUBCHRONIC REFERENCE DOSE (RfD_S)

6.1.1. Oral (RfD_{SO}). The results of the NCI (1978) bioassay in which ingestion of hexachloroethane was associated with a significantly increased incidence of hepatocellular carcinoma in male and female mice preclude the derivation of an RfD_{SO} for hexachloroethane.

6.1.2. Inhalation (RfD_{SI}). The results of the NCI (1978) bioassay in which hexachloroethane was associated with a significantly increased incidence of hepatocellular carcinoma in male and female mice preclude the derivation of an RfD_{SI} for hexachloroethane.

6.2. REFERENCE DOSE (RfD)

6.2.1. Oral (RfD_O). The results from the NCI (1978) bioassay indicate that a significant increase in the incidence of hepatocellular carcinomas in male and female mice is associated with the ingestion of hexachloroethane. Therefore, it is not appropriate for the purposes of this document to derive an RfD_O or a chronic toxicity CS based on the systemic toxicity of hexachloroethane.

6.2.2. Inhalation (RfD_I). The results from the NCI (1978) bioassay indicate that the ingestion of hexachloroethane is associated with a significant increase in the incidence of hepatocellular carcinomas in male and female mice; therefore, it is not appropriate to derive an RfD_I or a chronic toxicity CS based on the systemic toxicity of hexachloroethane. If it becomes evident that the carcinogenicity of hexachloroethane is route-specific, however, values for an RfD_I and chronic toxicity CSs could be derived from the study of Weeks et al. (1979). The U.S. EPA (1983) derived CS values from the LOAEL identified at exposure to 260 ppm (2520 mg/m^3) associated with tremors and decreased survival rate in rats and guinea pigs, respectively.

6.3. CARCINOGENIC POTENCY (q_1^*)

6.3.1. Oral. Hexachloroethane was associated with a significantly increased incidence of hepatocellular carcinoma in male and female B6C3F1 mice (NCI, 1978). Based on the data from male mice, the U.S. EPA (1980a) calculated a human q_1^* of 1.42×10^{-2} $(mg/kg/day)^{-1}$. This q_1^* is adopted as the estimate of carcinogenicity of hexachloroethane by oral exposure for the purposes of this document.

6.3.2. Inhalation. Pertinent data regarding the carcinogenicity of hexachloroethane after inhalation exposure could not be located in the available literature.

7. REFERENCES

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APPENDIX

Summary Table for Oral Toxicity of Hexachloroethane Using Male Mice

Experimental Exposure/Dose (mg/kg/day)	Effect	q_1^* or Unit Risk
0, 590 or 1179 mg/kg/day, 5 days/week for 78 weeks (gavage)	Statistically significant increased incidence of hepatocellular carcinoma	1.42×10^{-2} $(mg/kg/day)^{-1}$

*Source: NCI, 1978; U.S. EPA, 1980a